
Space Weather Technical Forecast

Issued on Thursday 13 March 2025 at 13:23 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Isolated M-class flares likely. Chance of G1 Minor Storms day 4 (13 Mar)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C6.8 from the plage area near ex-AR4016 in the southeast disc. This is despite the ten regions currently on the Earth-facing disc, including two with delta configurations. The most notable of these is AR4019 in the north-centre disc, with a further delta spot evident on AR4021 in the southeast. The other region of note is AR4028, which was recently numbered, and is still moving onto the Earth-facing disc from over the southeast limb.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, showed a connection to CH22/-. Wind speeds were initially background, around 400 km/s but soon rising to elevated by 12/1500 UTC, then persisted 490-550 km/s. Density was mostly below average. Interplanetary Magnetic Field strength, Bt, eased from Moderate, near 11nT, to be Weak at 7nT. The north-south component, Bz, eased from mainly Moderate negative to be Weakly negative, ranging from +7 to -11nT. Phi angle was negative (towards the Sun). Geomagnetic activity was Active (Kp4) to G1/Minor Storm (Kp5).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background. High energy electron flux (greater than 2 MeV) was initially High, recording a max of 1990 pfu at 12/1550UTC. The 24-hour fluence started above the Active threshold (1e8 integrated pfu) but has fallen below since 12/1800UTC, with 5.33e7 integrated pfu observed at 13/0000 UTC.

Four-Day Space Weather Forecast Summary

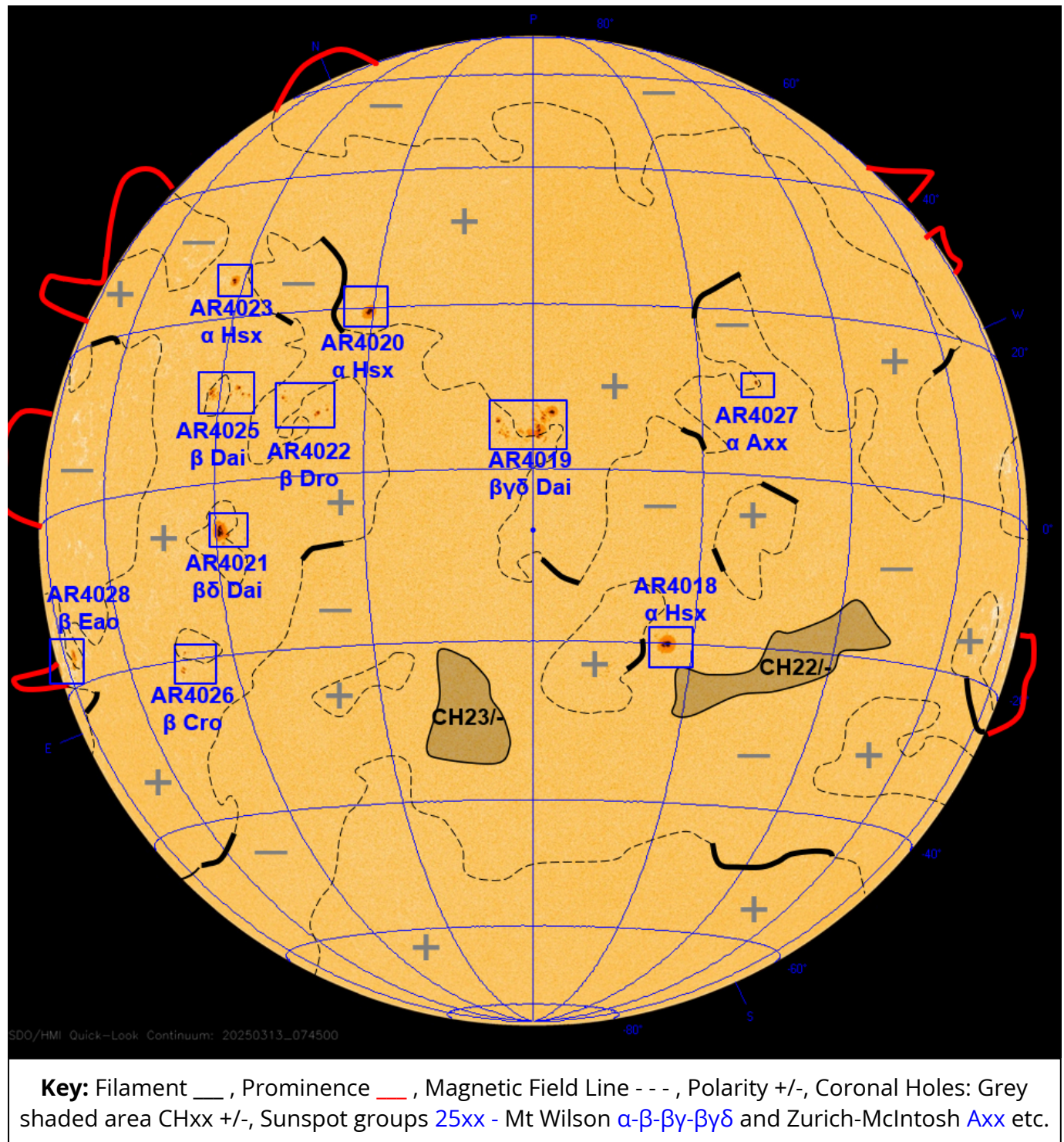
Solar Activity: Low to Moderate activity is likely, with isolated M-class flares and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing fast wind of CH22/-, currently near 550km/s, is expected to ease a little day 2-3 (14-15 Mar), before a further enhancement is likely from any fast wind from CH23/- day 4 (16 Mar). Geomagnetic activity is expected to become mainly Quiet to Unsettled with isolated Active intervals and a slight chance of

G1 Minor Storms by day 2 (14 Mar). Any upcoming enhancement day 4 (16 Mar) brings a chance of a further spell of Active to G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background. High energy electron flux is expected to recover day 2-3, likely rising to High, with a chance of the associated 24 hour fluence becoming Active (greater than $1e8$ integrated pfu). Confidence lowers by day 4 (16 Mar), with flux likely to become suppressed by any further fast wind onset, from CH23/-.

Figure 1: MOSWOC Solar Synoptic Map 0800 UTC.



Geomagnetic Storms

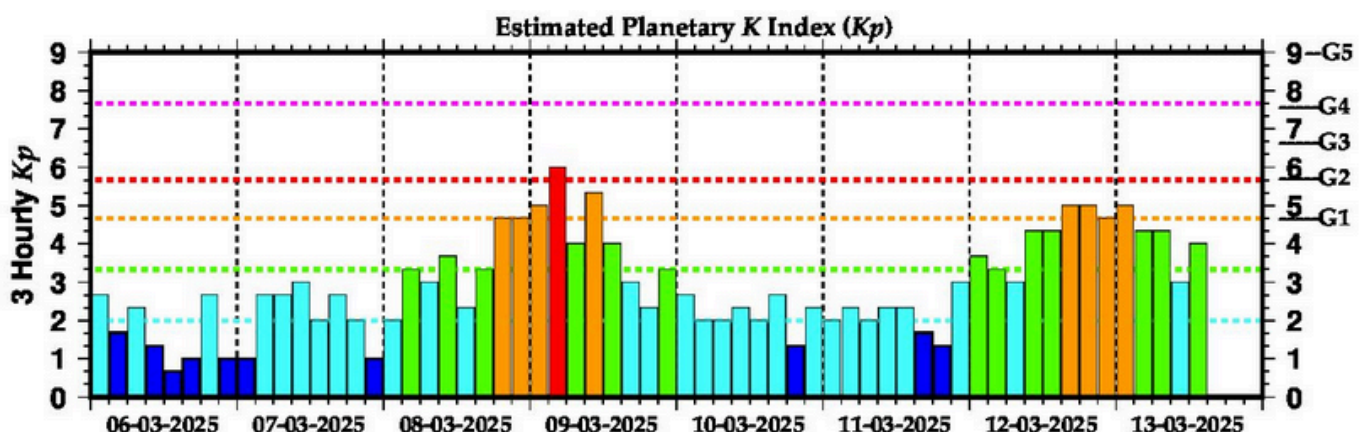
There are no Earth-directed CMEs.

Solar winds are currently Elevated due to the fast wind of CH22/- with speeds 500-600 km/s and ongoing periods of southward orientated IMF that have led to a spell of Active to G1 Minor Storms. Ongoing fast winds at first will only gradually ease day 2-3 (14-15 Mar), before the next enhancement is likely to occur on day 4 (16 Mar) due to CH23/-. This is a more uncertain enhancement, as this feature is both further south, and was also combined with CH22/- to form a single feature on the previous rotation. Any subsequent CIR region is consequently low confidence, with some potential for just an ongoing weak enhancement

Overall, mainly Unsettled to Active geomagnetic activity, with isolated G1 Minor Storm intervals at first, is expected to become mainly Quiet to Unsettled with isolated Active intervals and a slight chance of G1 Minor Storms by day 2 (14 Mar). Any upcoming enhancement day 4 (16 Mar) brings a chance of a further spell of Active to G1 Minor Storm intervals.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	60	10	5	50
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: BGS Estimated Geomagnetic Activity.



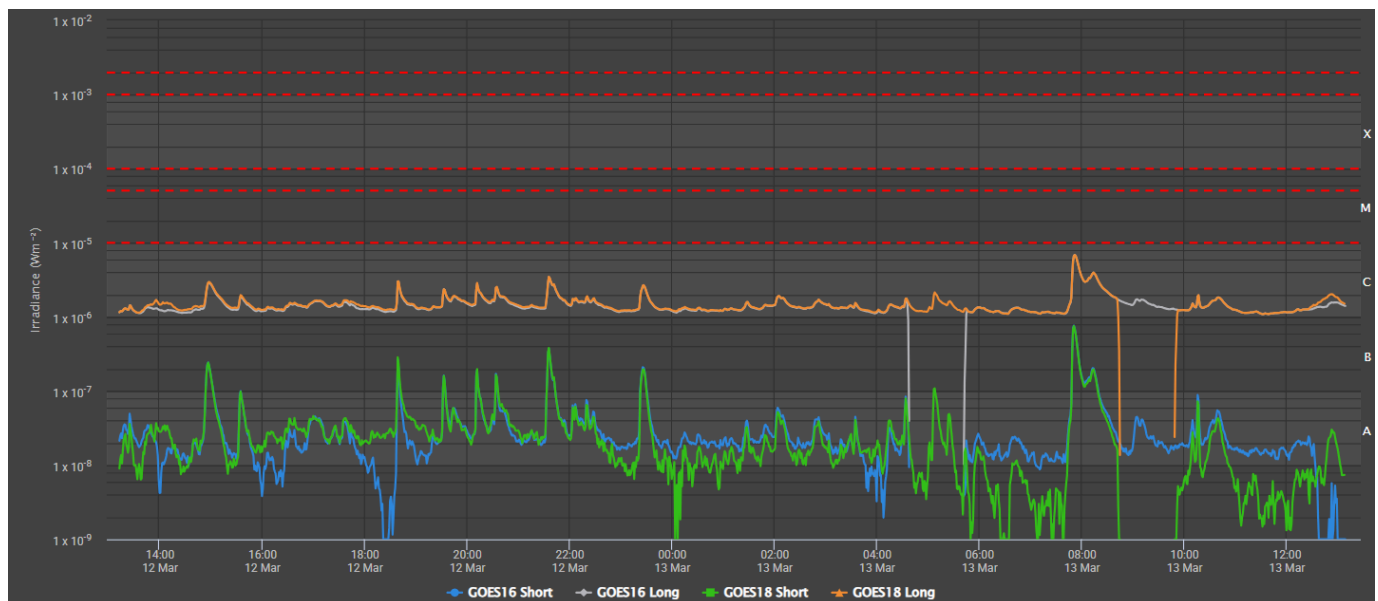
Radio Blackouts - X-Ray Flares

Low to Moderate activity is expected with a likelihood of occasional M-class flares and slight chance of X-class flares.

The main flare risk is currently from AR4019 in the north-centre disc. This is a relatively small region, but with a moderately strong delta spot on its southern periphery and a relatively complex magnetic structure. AR4028, which has recently moved onto the disc, also has a flare potential with some complexity likely to become visible as this moves to a less oblique viewing angle, with some notable looping above the disc. The other eight regions on the disc are relatively small and simple regions, with a number of mature unipolar spots. The only other exception is AR4021 in the southeast quadrant, due to a very small delta spot on its leading edge.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES16/18 X-ray Irradiance

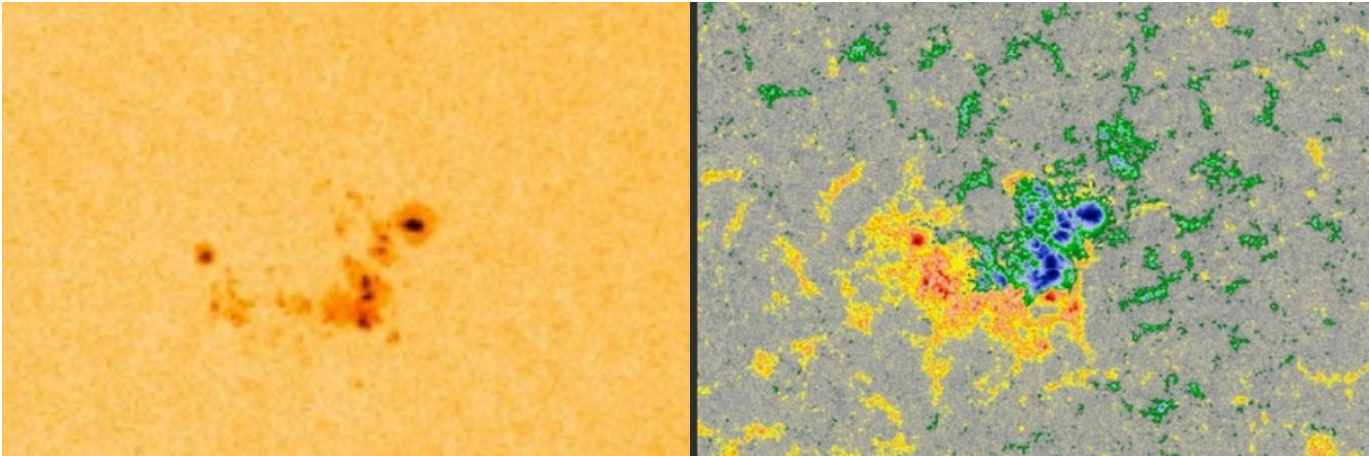


Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background, with only a slight chance of enhancement given any notable flares from the regions currently on the Earth-facing disc. This is perhaps most likely from any notable activity from AR4019 in the north-centre disc.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

Figure 4: SDO Intensitygram and Magnetogram of AR4019 showing moderate strength delta spot.



High Energy Electrons ($\geq 2\text{MeV}$)

The high-energy electron flux ($>2\text{MeV}$) observed at GOES16 recently became suppressed due to the onset of the fast wind of CH22/+. These fast winds are likely to ease a little day 2-3 (14-15 Mar) which could allow for an outward expansion of the Van Allen belts, and a subsequent increase in the observed flux at GEO, likely reaching Moderate to High for a time. Confidence becomes very low by day 4 (16 Mar) however, with the potential re-enhancement to the solar wind from the onset of and fast wind from CH23/-. This could lead to flux dropping out towards background.

Overall the fluence is expected to see a rising trend, with a chance of reaching Active ($1\text{e}8$ integrated pfu) by the end of day 2 (14 Mar). This chance then persists through the rest of the period, albeit with decreasing confidence day 4 (16 Mar). This is supported by 27 day persistence, with MOSWOC REFM also showing a rising trend, although later in the period than currently forecast.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^8$	Yes	10	50	50	30
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron flux and fluence with associated MOSWOC REFM and Persistence

